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Costing Iron Castings

More foundries have gone out of existence through their inability to cost rather than their failure to make saleable castings, assuming, of course, that no foundry owner consciously sells his product below a price which returns, at least, some profit. For several decades, foundrymen of many nations have co-operated with the object of producing systems which would enable the various makers of castings to cost their products intelligently. Moreover, the ultimate aim has usually been the institution of a unified system, which, if nationally adopted, would ensure the quotation of equitable prices—that is the basis of these prices would be both realistic and truly comparable with those emanating from other sources. Excellent work has been done by the Institute of British Foundrymen, the American Foundrymen's and the Bronze and Brass Founders' Association. Now the Council of Ironfoundry Associations has just published from its headquarters—Derbyshire House, Belgrove Street, Kings Cross, London, W.C.1, "Cost Ascertainment Methods for the Ironfoundry Industry based on Uniform Principles."* In general terms this Report by the Costing Committee of the C.F.A. consists of the presentation of detailed charts, set out in tabular form, with adequate textual annotation, plus, of course, statements as to general purpose. In the past, most systems have been criticised on three grounds (1) the figure which should be used for evaluating the cost of domestic or home scrap when charging back into the cupola, (2) the allocation of overheads, and (3) over complication.

In this Report, home scrap is evaluated at the average price of the purchased metals in the mixture used. Our mind immediately went to the case where much high-alloy scrap was used, but we found that this was taken care of by the note that it should be valued at the price of the mixture from which it originated. We can envisage no more sensible solution than the one now offered. The question of overhead costs and their absorption as a percentage of direct labour, or by other means is adequately dealt with and by the proper departmentalising of the foundry, resolution should now be simple. The third criticism, that of over complication, will, we believe, still exist. To the quite small founder, it does seem rather formidable, but he must not despair. It is not easy for us, but bit by bit we do get a proper understanding, for it is much clearer than most Government forms. Thus our advice to the small jobbing founder is to take the book to his auditor and get him to indicate which of the figures set out he must ascertain in order to conduct his business properly, and still to do this within the framework of the unified system disclosed.

When the Institute published their Report, it was discussed in "tentative" form at many Branch meetings. We felt at the time, however, that whilst many useful pointers were disclosed, most of the participants were insufficiently versed in accountancy to make really worthwhile contributions. This new Report is obviously a professional production, reinforced by the advice of those whose job it is to operate foundries. To the best of our ability, we have tested it for completeness, and in every case we have found it satisfactory. It now remains for the industry to implement its findings. If there be weaknesses, they should be pointed out as early as possible. As all items are numbered, discussion on any point is made easy. We are assured moreover, that the C.F.A. will welcome criticisms.

*This is to be issued free to all members of the constituent associations, extra copies supplied at £1 1s. For the general public the price is two guineas.

Contents

Costing Iron Castings, 1.—Notes from the Branches, 2.—Production of Cast Crankshafts, 3.—Book Reviews, 6.—Basic Cupola Practice, 7.—Institute Elects New Members, 12.—The Boy's Own Foundry, 12.—National Brassfoundry Association, 12.—Imports and Exports of Iron and Steel, 13.—Gazette, 14.—Parliamentary, 14.—Obituary, 14.—Presentation to Mr. T. A. McIntyre, 14.—Personal, 15.

Notes from the Branches

Wales and Monmouthshire

On March 29 the lecture session closed with a Paper by Mr. S. A. Horton, hon. secretary of East Midlands Branch, entitled "Planning and Preparing Pattern Equipment." The subject was profusely illustrated with a range of slides that were of great assistance in following the course of the lecture, and Mr. Horton retained the interest of a well-attended meeting throughout his talk. An interesting discussion followed, the lecturer's replies being especially appreciated.

Proposing a vote of thanks, MR. R. G. WILLIAMS said he had followed every word of the lecture with real interest. He believed not only in co-operation between patternshop and foundry when deciding upon moulding and casting details, but was sure that many draughtsmen would benefit by a period in the foundry. Experience thus gained would obviate many moulding problems that so frequently arise.

MR. G. M. BROWN seconded this vote, which was carried with acclamation.

MR. HORTON replied briefly, expressing his pleasure at the interesting discussion, which was an indication of the attention of his audience.

East Anglia

The annual general meeting was held on April 10, in the Lecture Hall, Central Library, Ipswich. The President, Mr. A. F. Hammond, occupied the chair, and there were 22 members and two visitors present. The secretary, Mr. A. N. Sumner, in presenting his annual report, said:—

The past year had witnessed reversion to the normal pre-war winter session of monthly meetings. In all seven meetings had been held from October to April, inclusively. The first of these was, by the courtesy of the management, a visit to the Suffolk Iron Foundry (1920), Limited, Stowmarket, followed by "The Production of Grand Slam Bomb Castings," by B. Gray; "Short Visit to U.S.A.," by F. E. Tibbenham; "Control Tests for Grey Cast Iron," by Sub-committee T.S.6 (J. Blakiston); "The Production of High Quality Steel," by Hadfields (W. H. Salmon); and "Foundry Inquest, Fault and Cure." Invitation to enter a short Paper competition on "Core Production" brought very limited response, and the entries, in place of being publicly read at an additional meeting, are being submitted to the Council for judgment. The annual dinner and smoking concert scheduled for November, although subsidised from the Section's social fund, had unfortunately to be cancelled because of insufficient support.

The membership strength of the Section had once again improved, as since the last annual general meeting only one member had, through transfer, been lost, while eight new members had joined, making an increase of seven members and bringing the total for the Section to 87 members and one member firm. As a result of the abnormally severe winter, some meetings received very poor support. Despite this, however, the average attendance during the session had slightly risen to 33 members per meeting, representing 38 per cent. of the present total membership, compared with 35 per cent. for the previous session. Here must be recorded the gratitude and appreciation of the Council and members to visiting lecturers, some of whom travelled long distances in extremely deterring conditions to address the Section.

Examination Successes

Results of the City and Guilds examination in foundry practice and science show continuation of the earlier successes attained by the class in this subject at the Ipswich School of Technology. Mr. A. Palmer, the only student from the class, eligible last season for entry, had gained a first-class pass and had been awarded the Buchanan Silver Medal of the Institute and the City and Guilds Bronze Medal. This year seven students had completed the course and would be taking the intermediate examination in early May. By the end of next session a similar number would be eligible for the final examination. The Technical Education Advisory Committee had met and arrangements had been made for improved facilities for practical training.

MR. R. F. COATES, in proposing the adoption of the report, thought that Mr. Sumner had not, probably from a sense of modesty as instructor, laid sufficient stress on the fact that since the fairly recent inauguration of the course, on the two occasions that students had been entered for the City and Guilds Foundry Practice and Science examination, on each occasion a national award had been gained. He suggested that the report be amended to lay stress on this achievement. Mr. L. W. Sanders seconded the proposal, and the report was adopted.

The following officers were elected for the ensuing session:—

President, Mr. R. F. Coates.

Vice-Presidents, Mr. L. W. Sanders and Mr. W. L. Hardy.

Hon. Secretary, Mr. A. N. Sumner.

New Councillors: Mr. A. H. Horton, Mr. G. H. Newman and Mr. R. J. Hart.

"*Foundry Inquest.*"—The meeting was adjourned for 15 minutes to enable the members to examine the specimen castings, comprising a defective brake drum, a car jack casting, a fan pulley, and a 4-in. pump casting.

A lengthy and interesting discussion ensued. The meeting closed with a vote of thanks by Mr. Hardy, seconded by Mr. C. H. Kain to the chairman.

The monthly Statistical Bulletin of the British Iron and Steel Federation shows that in December, 1946, the iron foundry industry gained a further total increase of 1,074, of which there was a net gain of 1,308 males and another loss of 234 females. During the year the total gain registered is 26,489; of men there were 27,096 associated with a loss of 607 women. The average weekly earnings per worker have risen during the year from £5 16s. 0d. to £6 6s. 8d.

Steel for steel castings rose in January by 100 tons to reach 6,800 tons, as compared with 6,100 in January, 1946. Deliveries were of the order 2,800 tons per week, which compares with 2,900 tons in December, 2,800 in January, 1946, and 4,100 tons in 1945.

Production of Cast Crankshafts*

Part I

By R. B. Templeton

The object of this Paper is to establish between designer, engineer and foundryman, a basis on which the design and production of cast crankshafts can be envisaged and the various points of view merged into general agreement. The increasing interest in the use of cast crankshafts makes it urgent that the problems of design, application, and production should be overcome. It is the author's aim to indicate how some of these problems may be solved.

Several large organisations engaged in engine building have dealt with this problem on rational lines. For instance, the Ford Motor Company have developed a cast metal of high tensile strength, good wearing qualities, and with high resistance to fatigue and shock loading. They have developed a special foundry technique in this metal for the mass production of their crankshafts and lastly they have designed the crankshaft to suit the particular properties of this metal and its casting technique. This is rational planned development, but such planning is only possible within the organisation having a production capable of supporting it. Other large motor car manufacturers have dealt with the problem on similar lines, but for the general run of engine builders their output does not justify such a plan.

What then is the attitude of mind of these miscellaneous engine builders to the use of the cast crankshaft? It is obviously one of caution. They have for years used steel with economic and service satisfaction. They realise the possibilities of the cast crankshaft and its advantages. They know that it gives them a wider choice of materials, but they feel that the casting cannot entirely supersede the use of a forging or stamping, and therefore that certain good properties of iron must be sacrificed on the altar of interchangeability. At the present stage of development the cast shaft must prove itself capable of withstanding the working conditions and stresses, and must conform to the scantlings of the forged or stamped shaft before it receives universal acceptance.

The author has been associated over the past twelve years with the manufacture of over 50,000 cast crankshafts. These vary in weight from 10 lb. to 3,000 lb., and embody a range of over one hundred different types and sizes. In very few cases has the designer boldly accepted the structural properties of a high tensile cast iron to best advantage. This is a severe handicap to the cast shaft, but one with which it will have to contend for the time being.

*A Paper (abridged) read before the Institution of Automobile Engineers; the author is Managing Director, Ealing Park Foundry, Ltd.

Certain primary considerations are essential in design such as—What operating stresses and loading will it stand? How long will it operate under these conditions, and how much will it cost? Having determined these basic requirements, the designer can decide which properties are most important. For example, of strength, wear resistance, or rigidity he may decide that for his particular purpose rigidity is of first importance. Here he is in the happy position of knowing that a casting can be stiffened up by redesign and correct location of material to obtain the desired degree of rigidity.

Physical Properties

It is worth while to set out these properties and try to picture their interrelation in terms of the actual crankshaft in operation, and how the working life of this highly sensitive component is affected by the different properties of these materials. A relation of the properties of high tensile steel, mild steel and "Meehanite" cast iron has been summarised in Table I.

TABLE I.—*Physical Properties of Crankshaft Materials.*

Item.	Property.	Alloy steel.	Mild steel.	Meehanite
1	Ultimate tensile strength, tons per sq. in.	50	32	26
2	Ratio of fatigue to tensile	0.45	0.48	0.55
3	Fatigue strength, tons per sq. in.	±22.5	±15.3	±14.3
4	Percentage loss on notch effect	30 per cent.	25 per cent.	12 per cent.
5	Resultant fatigue strength, tons per sq. in.	±15.7	±11.5	±12.6
6	Modulus of elasticity E, lb. per sq. in.	29,000,000	29,000,000	22,000,000
7	Modulus of rigidity G, lb. per sq. in.	11,500,000	11,500,000	8,700,000
8	Torsional modulus of rupture, tons per sq. in.	46.5	30	32
9	Ratio torsional fatigue to tensile	0.36	0.36	0.45
10	Torsional fatigue, tons per sq. in.	±18	±12	±11.5
11	Brinell hardness	250	160	240

Item 1.—Shows the tensile strengths obtained in routine production of the three materials.

Item 2.—These ratios are accepted and substantiated by several researches, notably that of Gough and Pollard on "Resistance to Combined Fatigue Stresses."*

Item 3.—Shows how the above strengths are affected by these ratios.

Item 4.—The loss percentage due to notch effect are also substantiated by the above research.

Item 5.—Shows the resultant fatigue strengths. These are the actual ones under which the component operates. They are important, and are values on which all calculations should be based. It will be seen that "Meehanite" compares favourably with mild steel and is not greatly inferior to alloy steel.

* I.A.E. Proc., Vol. XXXI, p. 821.

937358

Production of Cast Crankshafts

Items 6, 7 *and* 8.—These are accepted values and show the cast iron to be inferior to the steels.

Item 9.—Shows the ratios of torsional fatigue to tensile, and these ratios are likewise substantiated by the above research.

Item 10.—Shows the torsional fatigue values of the three materials.

Item 11.—These Brinell figures are of forgings, stampings and castings in the unhardened state.

Dealing with Table II, Item 1 indicates broadly the relative strengths as obtained on separate test-pieces.

TABLE II.—*General Comparative Summary.*

Item.	Property.	Alloy steel.	Mild steel.	Meehanite.
1	Strength	Good	Satisfactory	Adequate
2	Notch sensitivity ..	High	Medium	Low
3	Damping capacity ..	Low	Medium	High
4	Shock resistance ..	Very good	Very good	Satisfactory
5	Wear properties :			
	Not hardened ..	Fair	Poor	Excellent
	Hardened	Excellent	Very good	
6	Cost of hardening ..	High	High	Nil
7	Machining properties ..	Good	Fair	Excellent
8	Freedom in design ..	Limited	Limited	Unlimited

The adverse influences of (Item 2) Notch Sensitivity, must never be overlooked in assessing the strength value of the actual crankshaft, particularly where the drilling of the oil channels might give rise to peak stress concentrations.

Item 3.—Damping capacity is a resultant of the ratio of plastic to elastic strain and is a safeguard against the building up of resonance stresses. A high duty cast iron is four to six times more efficient in this property than a 0.23 carbon steel, an advantage, though not a major one, in the total damping of an engine.

Item 4.—Comparison of resistance to shock is difficult to make and there are wide differences in the three materials. As impact resistance has little importance in a crankshaft, the Author considers that the low Izod value of cast iron has no great significance.

"Crankshaft Design and Manufacture," by J. Smith,* sets out some interesting and rather outstanding test results on cast iron compared with steel, and shows that cast iron is highly resistant to fracture under certain conditions of repeated impact on notched bars, which is basically the type and nature of loading a crankshaft has to withstand.

Item 5.—Wear resisting properties are dealt with fully in a later section of the Paper. "Meehanite" in the "as-cast" state is outstanding in wear resistance and heat treatment is neither necessary nor desirable.

Item 6.—Cost of hardening is an important factor in final cost, and to obtain the best wear resisting properties steel must be hardened. It should also be remembered that local hardening might introduce a danger of stress concentration unless carefully applied.

Item 7.—Machining properties are dealt with under "Dimensional Tolerance" and Item 8—"Freedom in Design"—is also dealt with later in the Paper.

* Published, Whitehall Technical Press.

The designer might well ask the foundryman—Why not improve the properties of cast iron where they compare unfavourably with steel? Why not improve its strength? This can be done; in fact, to-day cast irons are being made with U.T.S. of 35 to 40 tons per sq. in. The Author is not, however, convinced that this is a wise answer, because any increase in strength entails a sacrifice of damping capacity, an increase in notch sensitivity, and, due to the reduced volume of graphite and changed structure, a sacrifice of wear properties. Perhaps most of all, owing to the greater difficulty in casting, an uncertainty in soundness. Uniformity of structure throughout the crankshaft is the final criterion of its durability in service.

Dimension Tolerance

The amount of metal to be removed is the governing factor in machining costs. Tolerance on a drop stamping is comparatively small, but castings can be produced to similar tolerance. In a casting it varies with size. Length can be held within $\frac{1}{32}$ in. on small and medium shafts, and the allowance for taper on vertical faces is negligible compared with 5 deg. taper on a stamping.

This accuracy and absence of taper eliminates machining of the webs and balance weights. Many cast shafts up to 4 ft. in length have been produced with machining only on the bearings and journals, and a clearance of $\frac{1}{32}$ in. between location faces and the sides of the webs. The machining allowance on the bearings of small shafts can be $\frac{1}{16}$ in. on radius, and the ideal is to cast to a grinding allowance which is by no means impracticable.

With increasing size, it is usual to allow $\frac{3}{16}$-in. to $\frac{1}{4}$-in. cut. Distortion in a cast shaft is rare and need not be considered in fixing such allowances. On larger shafts for small quantity production the tolerance of a casting compared with hand forging shows an even more outstanding advantage in favour of the casting, and numbers have no influence on dimensional accuracy. Small scale forging production leaves much to be desired from this point of view, and it is usual to make liberal allowance for the complete machining of such a forging.

Production Time

The factors mentioned in the last paragraph were very important during the war, when the bottleneck in machining capacity was a limiting factor in crankshaft output, and it was then the opinion of Crankshaft Control that castings had the following advantages:—(1) Important saving in material compared with shafts forged from steel billets; (2) heat treatments between roughing processes were obviated; (3) considerable reduction was achieved in machining hours, and (4) wastage of material and of man-hours was generally reduced.

Figures supporting this claim were completed by the Control and are given in Table III. Seven of these were for Diesel engines and two were for compressors. Of the aggregate output of 98 shafts per month, there was a saving of 25 tons of material and, of paramount importance during the war, a saving of 3,691 man and machine hours.

Heat treatment

It is natural to ask what improvement in physical properties can be obtained by heat-treatment of cast-iron crankshafts. The normal high-duty irons are amenable to heat-treatment. By an oil quench around 850 deg. C. a hardness of over 500 Brinell is produced, and, as in the case of steel, tempering produces a breakdown of the martensitic structure and a reduction in hardness proportional to the tempering range. The curve for tensile strength also takes the same form as in steel.

It is advisable at this point to differentiate between the normal pearlitic irons and those alloyed with nickel and molybdenum, which, by a specific low temperature heat-treatment, aim at an acicular structure of high static strength and hardness. These irons, on account of their distinctive structure, have quite different wear resistance and dynamic properties, which call for separate consideration from those of the pearlitic range.

The enhanced properties of heat-treated irons are of value in applications such as gears, cylinder liners, with a stress relief treatment which has no other physical effect. It is the standard practice of the Author's firm to heat shafts to 550 to 600 deg. C. for a period of 4 to 5 hours, followed by slow cooling to remove residual casting stresses. This is an insurance rather than a proved necessity, and does remove 60 per cent. of any remnant stresses. Repeated tests have proved that the structure, hardness, and tensile strength are not influenced in any way.

Wear

Resistance to wear is of vital importance, as it controls the useful life of a crankshaft, and to get evidence on this point the author recently obtained an opinion from six different users of cast crankshafts. They were unanimous in the opinion that the wearing properties of cast shafts were superior to those of steel, both so far as the shaft itself and the bearings were concerned.

It cannot be claimed that the problems of wear resistance are fully understood, although the study and research given to this property of metals far outstrips that given to any other property. Wear problems encountered in engineering are so diverse, ranging as they do from heavily loaded dry friction to high-speed well-lubricated conditions, and it is impossible to generalise. Two important factors in crankshafts are surface finish and metal structure. It is not proposed to enter the controversial field of the former, except to state that after a short running-in period, a cast-iron shaft takes on a mirror-like finish which is highly resistant to further wear.

The retention of an oil film is the over-riding consideration and the structure of a bearing is determined with this in view. The structure of a good cast iron has a similarity to that of a bearing metal. Small graphite flakes well distributed, help to retain lubricant, and the pearlite matrix is hard enough to provide a good wear-resistant surface.

Any interruption or breakdown of the oil film gives momentary metallic contact and may cause local welding of the bearing and shaft materials. Cast iron is less liable than steel to this local fusion presumably

(*Continued overleaf, column* 2.)

TABLE III.—*Comparative Figures of Material Loss and Machining Times of Steel and Cast Iron Crankshafts.*

Type of engine.	Forgings.			Castings.			Savings.	
	Lb. Rough weight.	Lb. Finish weight.	Hours. Machine time.	Lb. Rough weight.	Lb. Finish weight.	Hours. Machine time.	Lb. Material	Hours. Machining.
Diesel :								
6-cyl.	2,520	657	160	700	637	80	1,800	80
6-cyl.	1,344	287	100	256	216	30	1,017	70
4-cyl.	672	140	60	177	141	34	496	26
4-cyl.	924	279	73	300	278	55	623	18
6-cyl.	1,316	330	75	364	354	34	976	41
3-cyl.	469	133	73	120	96	24	312	49
4-cyl.	630	168	84	159	126	51	439	33
Compr. :								
4-cyl.	616	93	55	114	87	24	496	31
2-cyl.	364	72	65	101	74	35	265	30
Total for one of each type ..	8,855	2,159	745	2,291	2,009	367	6,424	378

etc., but in the author's opinion it is doubtful if they are an advantage in crankshafts which involve dynamic stresses. Much research has been done in this field. The Cooper Bessemer Company, of America, who have made some of the largest cast crankshafts, have investigated the effect of heat-treatment on bending and torsional fatigue limits on actual crankshafts and test-pieces cut from crankshafts. Their conclusions are that whilst the static strengths are greatly increased there is no appreciable improvement in endurance limits.

The increased static strength is offset by loss in other directions. Impact value is reduced, and though it has been said that this is not a vital property in crankshafts, a reduction is undesirable. An increased susceptibility to notch effects is particularly important, though difficult to express numerically, and there is also a reduction in damping capacity.

These conclusions are supported by actual experience and it is significant that, of the few failures which have occurred, the majority have been on heat-treated shafts. The foregoing has dealt with heat-treatment processes designed to modify the structure and the properties of the material. These processes must not be confused

Production of Cast Crankshafts

due to the protective influence of the surface film emanating from the graphite flakes.

An interesting test was recently carried out by the Glacier Metal Company on a machine designed to obtain accelerated test results of the operating conditions in a motor car engine. The test consists of a run of five hours with a check for examination, and then a run of 25 hours, which is approximately equivalent to 25,000 miles road service. Test shafts are fitted with eccentric weights to produce a rotating bearing pressure of 2,140 lb. per sq. in. The machine carries four test shafts with two bearings each, so that eight tests are running simultaneously.

Results are given below of a test carried out on a 5 per cent. nickel steel, mild steel and "Meehanite" running in Glacier Metal Company type D.C.1. bearing containing 89 per cent. Sn., 7.5 per cent. Sb., 3.5 per cent. Cu. The wear on the steels was somewhat erratic, but on the "Meehanite" shafts there was little variation in shaft or bearing wear and the results were considered to be of outstanding importance for a tin base bearing material. Averages were as follows:—

Material.	Bearing wear.	Shaft wear.
	In.	In.
5 per cent. nickel steel ..	0.002	0.0015
Mild steel	0.001	0.0020
Meehanite	0.0004	0.0007

Where conditons of loading permit, tin base bearings of the type above are to be preferred, but the heavier pressures in many modern diesel engines demand other materials. In such cases copper lead bearings, either sintered or cast, are used, and for best results with these bearings it is necessary to heat-treat steel shafts to maximum hardness or plate with hard chromium. Such treatments are not necessary with cast shafts, which give better results at the normal "as-cast" hardness of 230/250 Brinell than can be obtained on hardened steel or chromium plated steel shafts.

(To be continued)

ZINC DEVELOPMENT ASSOCIATION, of Lincoln House, 15, Turl Street, Oxford, in its annual report for 1945-46, give an account of the year's work performed by the Association and its two affiliated associations, the Zinc Alloy Die Casters' Association and Zinc Pigment Development Association. The report opens with a survey of the various uses of zinc since the end of the war. All established uses, and especially galvanised coatings and rolled zinc, show a highly satisfactory increase, while many new applications, such as zinc metal-pigmented paints, have been expanded. The many and various forms of the information service—such as the Z.D.A. monthly abstracts, the reference library, lectures, etc.—are described. Difficulties experienced in the publication of technical literature have been largely overcome by the issue of a series of technical memoranda which convey the latest information to all inquirers on the chief topical subjects. The Z.D.A. Statistical Review, the only publication of its kind summarising published figures on zinc, has also met with a warm welcome from readers all over the world.

Book Reviews

"Marginal Costing." By F. C. Lawrence, M.C., and E. N. Humphreys. Published by Macdonald & Evans, 8, John Street, Bedford Row, W.C.1. Price 12s. 6d.

This is an excellent book, which should do much to stimulate thought on the question of costing generally, but its special virtue lies in the new angle presented in the examination of the fixed charges in relation to the business as a whole. For those concerns which have an established costing system, the marginal costing technique could be used with great profit. To those concerns which have no costing system installed, this book should be read as a warning, and with the intention of using the instrument available in marginal costing technique. Foundry concerns in particular will find this book on Marginal Costing both interesting and instructive, since many illustrations and references are made to the foundry industry.

A. N. W.

Statute Law Relating to Employment (2nd edition), by F. N. Ball, LL.B. Published by Stevens & Sons, Limited, 119 and 120, Chancery Lane, London, W.C.2. Price 25s. 9d., post free.

One wonders, in view of the plethora of industrial legislation now being enacted, whether this second edition, like the first, can be regarded as a standard reference work. Yet its importance cannot be denied. Last year saw two major acts placed on the statute book. These were the National Insurance (Industrial Injuries) Act and the National Insurance Act. They become effective as from appointed days, some of which are still unknown. These two acts are very fully covered in the last 70 pages of the book. As they change the whole basis, the wise employer would do well to include this book in his works of reference. Whilst there has been a stepping up of benefits, unless prices are stabilised, or, better still, decline, all these new works will be worthless. These legal books always have many interesting comments to make, as, for example: a man in prison temporarily loses his accident benefit; a man is deemed to be travelling if he has one leg and most of his weight on a vehicle.

Impact Test for Cast Iron

Under No. B.S. 1349-1947, the British Standards Institution have published a specification covering the impact testing of cast iron. This work, which has culminated in the issue of this specification, was initiated by the Technical Advisory Panel to the Director of Iron Castings during the war, as a potential replacement material for others in short supply. The personnel responsible were mainly drawn from the Technical Committee of the Institute of British Foundrymen and the staff of the British Cast Iron Research Association. A Paper was presented to the Iron and Steel Institute on the subject, Dr. Everest, Mr. Grant and Mr. Morrough being the authors. The availability of this new specification is a matter of considerable importance to the foundry industry.

Basic Cupola Practice

Recent Progress and Prospects

Part I

Meetings in which the Iron and Steel Institute, the Institute of British Foundrymen and the British Iron & Steel Research Association took part were held at No. 4, Grosvenor Gardens, London, S.W.1, on March 19 and 20, 1947, at which recent and future research problems were discussed in connection with the desulphurisation and dephosphorisation of cupola iron and pig iron, and side-blown converter practice.

On Wednesday, March 19, the meeting was held jointly by the Institute of British Foundrymen and the Iron & Steel Institute. Mr. D. Howard Wood (President of the Institute of British Foundrymen) presided. Three reports dealing with the desulphurisation and dephosphorisation of cupola iron and pig iron, giving the results of co-operative work under the auspices of the Technical Council of the Institute of British Foundrymen were presented and discussed.

The CHAIRMAN, opening the meeting, expressed the hope that co-operation on such matters would benefit the industry. Desulphurisation and dephosphorisation, he said, had been the concern of many leading metallurgists in the world, and particularly in this country, for the last 60 years or more; in one text book he had discovered references to 46 processes for the purification of molten iron.

It was the supply position during the war which had brought into existence the Basic Cupola Sub-Committee of the Technical Council of the I.B.F., whose reports were to be discussed. He believed that, in the not too distant future, the iron and steel industry in this country would have to depend to a more appreciable extent upon materials having sulphur and phosphorus contents of a similar order to those which had been employed during the late war.

It was made clear, in one of the reports, that the full-scale production technique in the reduction of phosphorus in cupola-melted irons was not commercially possible in practice; but it was hoped that further work might lead to a commercial process being developed. In that belief, the Sub-Committee had put forward a plea for the continuance of the work under the auspices of the British Iron & Steel Research Association. That Association had made arrangements to continue the work, and the Committee dealing with it would be enlarged by the co-option of a number of gentlemen who had been serving on the I.B.F. sub-committee. The meeting marked the end of a stage so far as the I.B.F. was concerned, and provided a springboard for the British Iron & Steel Research Association.

SIR CHARLES GOODEVE, F.R.S. (Director of the Research Association) said the reports provided a good example of co-operative research work between firms with common problems, who had put their experiences together for the common benefit. The Institute of British Foundrymen had shown the way to co-operative research very clearly in that particular field, and arrangements had been made to carry on the work under a slightly different organisation. He hoped and expected that it would not be vastly different from the past; it would add new strength to the organisation rather than end the one that had been so successful in producing the results to date, and which had, as the Chairman had aptly put it, provided a springboard from which to jump to the next stage.

MR. L. W. BOLTON (of John Gardom & Company, and Chairman of the Sub-Committee) introduced the first two Reports, printed in our issues of September 14, 1944, *et seq*, and July 4, 1946.

Discussion on First Two Reports

DR. W. C. NEWELL (British Iron and Steel Research Association) said he had reviewed the two reports extremely critically, with the object of seeing how best the work could be continued and of directing discussion to the future application of the work. His general impression was that there was more information in the Reports than had been truly digested in the text and in the summarising of conclusions. There had been insufficient consideration of the effect of temperature, and much of the information could have been clarified, had temperature measurements been made in a more satisfactory manner. There had been rather full consideration of the previous work by Heiken; but the conclusion drawn by Heiken, that the carbon content was higher with the basic lining as compared with the acid lining, was not substantiated in the first report, whereas in the work discussed in the second report it was found that a higher carbon content was obtained with the basic lining as compared with the acid lining. Dr. Newell suggested that it might be explained by a temperature effect.

Objectives Sought?

It was necessary to keep in mind the prime object of the work, and that was not too clear. Were they trying to obtain low-sulphur or low-phosphorus material, or greater and more efficient refractory life? It was not clear, whether statements made in the first report were observations, or whether they were recommendations as to what should be done. For instance, it was stated that the basic lining should have a thickness of 9 in. and should extend from the bottom of the shell to a height of at least 4-ft. 6-in. above the tuyeres, and so on. It would not appear, however, that the work had proceeded far enough to enable such generalisations to be drawn. The suggestion to use chemical bonds was likely to be very fruitful. It might well be taken up and they might examine the use of bonds for

Basic Cupola Practice

basic linings, which might give improved properties.

Dealing with the section of the first report concerning experiments on basic brick linings, he said it would appear that the case for bricks was not proved. There appeared to have been some reduction of the patching required during the first few weeks, but after that, the normal amount of patching seemed to be necessary. As to the statement that a 50 per cent. reduction of sulphur had been effected, he could not see figures in the report which indicated that.

The overall conclusion was that desulphurisation and dephosphorisation were possible in the cupola; but the conditions were rather antagonistic. It would be interesting to know whether any useful desulphurisation and dephosphorisation could be obtained at the same time and which was the more important. He suggested it would be logical to effect desulphurisation at one stage and dephosphorisation in another, *i.e.*, effect the one in the cupola and the other in the ladle, or *vice versa*.

Temperature Readings

MR. L. W. BOLTON said that Dr. Newell had put his finger on a weakness when referring to the few temperature readings given in the reports and this was well known to the sub-Committee. But the work was carried out under commercial conditions and because of that, the highly scientific aids, available to research investigators, were not available in that particular case. It would be extremely difficult to explore the temperatures at which reactions took place inside the cupola, though he did not say that it could not be done.

Commenting on the statement in the report that, when desired, sulphur contents of 0.03 to 0.05 per cent. could be obtained, he said that this was really the outcome of modesty on the part of the sub-Committee. He assured Dr. Newell that it was simply a question of working the cupola under sufficiently reducing conditions to obtain these low sulphur figures if they were required. It might not always be necessary to aim at a sulphur content as low as 0.03 per cent., but there was evidence available to show that it could be obtained.

He believed it was stated in the report that the main interest in the work on basic linings would be to obtain linings having longer life and which were more refractory. In his experience, the erosion of an acid lining, when melting ferro-manganese for 8 or 10 hrs. a day, was very serious. The slag produced was highly basic. He believed it was only in such cases that a basic lining would be used simply to obtain increased resistance to erosion.

The statements in the report, such as that quoted by Dr. Newell, concerning the thickness of linings, were based on experience; so that they could be regarded as definite recommendations.

Limited Simultaneous S. and P. Reduction

As to whether dephosphorisation and desulphurisation were possible simultaneously, he said the sub-Committee had stated that it appeared, from experimental work, that maximum dephosphorisation could not be obtained at the same time as maximum desulphurisation. But in a cupola, it was possible to have oxidising and reducing conditions in different zones, so that the sub-Committee felt that there was a chance that dephosphorisation might be effected at one level in the cupola, where the conditions were sufficiently oxidising, and desulphurisation later under reducing conditions.

Basic Refractory Bricks as Standard

MR. P. MURRAY (Refractory Brick Company of England, Limited) said that, with monolithic linings, there was no doubt that the main cause of failure was flaking. He added that equipment was being installed at Sheffield to test the hot strength of refractory materials with various bonds. He suggested that Dr. Newell had the wrong impression regarding brick linings. In the work mentioned in the first report, the brick linings had consisted of two courses of side bricks, so that after the first course had been eroded, the backing bricks were in rather a dangerous condition. Since then, further work had been carried out, with better results, so much so that brick linings were now standard practice at the works at which the experiments were made. It was also feasible that better results would be obtained by using end-arch bricks 9 in. thick instead of two 4½-in. courses. Until further work had been carried out on chemically bonded monolithic linings he did not think they could change from brick linings back to monolithic. From the refractory angle, the major worry was patching material and he suggested that if further work on the basic cupola was contemplated, priority of place should be given to the development of more durable and more economic patching materials, with less emphasis on the original linings.

MR. S. SPRAY (Stanton Ironworks Company, Limited), suggesting that oxidising conditions to obtain dephosphorisation were rather dangerous in cupola practice, said they would have some effect on the resulting iron castings, and would also result in poor blowing in converters; the answer might be subsequent de-oxidation, before blowing or before further use. On the question as to where the phosphorus went, he said that in the experiments at Stanton Gate, dealt with in the second report, he had found that much of it was lost in the following de-sulphurising treatment. The temperatures in the experiments were from 1,450 to 1,475 deg. C. They were based on the routine optical pyrometer temperatures, which were always found to be about 100 deg. lower than the immersion temperatures, and therefore were corrected by adding 100 deg.

Melting Ferro-Manganese

Mr. E. J. Brown (Hadfields, Limited), speaking as a steelmaker, said he had lined and used basic cupolas continuously from nearly 30 years ago up to the outbreak of the late war. The cupolas were lined with Austrian magnesite, suitably bonded, and used for the melting of ferro-manganese. Supplies of this type

of magnesite of course ceased in 1939, and recourse was made for some readily available national substitute. Experiments were at once made using stabilised dolomite both for cupola and ladle lining, and he thought he could claim to be the first to have successfully bonded and used this material for these purposes.

In the first report mention is made of the application of stabilised dolomite as a lining for the melting of ferro-manganese. This was inevitably a very wasteful method—the overall losses being anything up to 11 per cent., and as a consequence had in his works been discarded in favour of reverberatory furnaces.

Regarding the question of chemical bonds and the natural desire of the sub-committee to improve the ramming properties of stabilised dolomite, early experiments revealed two serious difficulties, firstly, there was a rapid de-hydration which rendered the ramming period too short, secondly (he had curiously not heard of this trouble elsewhere), due to its caustic effect it seriously attacked the men's hands, particularly at the finger tips. These two difficulties were overcome simultaneously by the application of about half per cent. of a vegetable oil which most probably acts as a waterproofing agent. In addition to preventing the action on the hands, it materially lengthened the ramming life, thus affording an opportunity to improve the ramming density.

Reviewing the reports, as a steelmaker Mr. Brown stated he was compelled to feel somewhat critical as to their immediate usefulness. They were extremely interesting, but at the moment probably more scientific than practical. Taking into account the present economic position regarding the availability of scrap, etc., we did not need a method of de-phosphorising for the converter process, whilst we had a relatively simple and efficient method of de-sulphurisation. Where a high degree of purity is desired the basic arc furnace fitted the bill admirably.

The question of the increased carbon pick-up was very absorbing and he had been trying to think of a theoretical reason for it. Mr. Bolton thought it might be ascribed to intermittent tapping. He could not subscribe to that view because this method of working is relatively common and such an associated feature is hitherto unknown. He was inclined to the view that the reason was due to some mechanical cause. It may be that in the acid process molten drops are enveloped in a protecting slag as distinct from the basic process. The phenomena were very intriguing and an investigation into the fundamental reason might have some definite value.

Better Patching Needed

MR. P. MURRAY agreed that stabilised dolomite had an adverse effect on the hands of workmen, and for that reason leather gauntlets had been worn when applying the material to the cupola walls. He had not found it necessary to incorporate ½ per cent. of oil with the material when ramming initial linings. When applying the original monolithic linings (in the experiments described in the first report) they had put 1 per cent. of liquid silicate of soda with the mixing water, but the silicate of soda migrated to the surface, producing a hard skin; the interior was not quite so hard and presumably would be weak at medium temperatures. He suggested that it was necessary to find a chemical bond, which was not water-soluble and which would not migrate to the surface, so that reasonable strength was obtained throughout the linings.

Magnesite was not used during these experiments because at that time the supply position was very grave. There was little doubt that magnesite was the best available material from the point of view of resistance to ferrous oxide slags, but even so the limited experience obtained during this work indicated that erosion would take place with this type of brick and patching material would have to be applied. Whether or not the use of patching material could be avoided by building a magnesite lining and using it until it had been worn out, depended on several factors. The major factor was the rate of wear in the melting zone and he felt that this would be so high as to rule out this solution to the problem; water cooling, however, was one device which would help to minimise refractory wear and was one aspect of this work well worth careful study. Attempts had also been made to reduce the amount of patching material required per day by building the original lining to the lines of wear. Successful results had been obtained on an experimental basis.

Carbon Pick-up

DR. T. P. COLCLOUGH (Iron and Steel Board), referring to the difference in carbon content of the metal when using a basic lining as compared with an ordinary ganister lining, suggested that the explanation was perfectly simple. The absorption of carbon by melted scrap was a function of time and temperature in the presence of carbon. In the experiments discussed in the First Report, where the continuous tapping spout was used, the metal was taken away, as quickly as it was melted, so that there was no appreciable pick-up. But at the Stanton Gate foundry, where the experiments described in the Second Report were conducted, 65 cwt. of melted metal were required at intervals of ten minutes. The cupola well was designed especially to store 3 tons of metal, with the result that the liquid iron was in contact with the coke for at least ten minutes. In normal practice the carbon absorption was between 2.8 and 3.2 per cent. In the experiments the amount of coke in the bed approached 6 tons, with which the 3 tons of metal was coming into contact, so that there was the maximum opportunity for the absorption of carbon. Again, with a basic lining, the temperatures were extremely high, approaching blast furnace conditions.

Whilst appreciating that the experiments were made under war-time conditions in two or three places and as a spare-time job, Dr. Colclough said that three problems were mixed together and he urged that they be separated. First, the problem of the basic lining for a cupola was a very definite one and should be tackled as such. Secondly, there was no question, as demonstrated by the work already done, that the basic lining of a cupola would permit a greater

Basic Cupola Practice

degree of desulphurisation than occurred in the ordinary cupola. In so doing it was necessary to operate with a basic slag and at higher temperatures, which meant higher coke consumption. Under present conditions, the quantities of coke used and the cost of coke were fundamental factors. He urged that desulphurisation should be effected outside the cupola. To use more lime and fluorspar and more coke by desulphurising in the cupola did not appear to be right.

Thirdly, dephosphorising seemed to him rather akin to trying to paint something black when one wanted it white. Desulphurisation required reducing conditions, and dephosphorisation required oxidising conditions. The most important reaction was that between carbon and P_2O_5. The reason there was dephosphorisation in the experiments covered in the First Report was that equilibrium was not approached; there was dynamic operation. Above the tuyeres there could be oxidation; the metal carried down with it iron oxide.

Automobile Practice

MR. BOLTON still felt that the problem of carbon pick-up was not solved satisfactorily. In the automobile industry, he said, there were many cupolas producing metal hotter than was produced from the Stanton Gate cupola; the charges had relatively high carbon contents, and they were melted at a higher temperature than at Stanton Gate, but, if they ever tapped metal with a carbon content of 3.9 per cent., there would be trouble. The higher silicon content of the automobile foundry metal, which was often stored for long periods in the well, would not account for the marked difference in carbon pick-up obtained.

The question as to whether desulphurisation should be carried on, inside or outside the cupola, depended entirely on circumstance. Advances had been made in the direction of obtaining very high efficiency of desulphurisation outside the cupola, and only in conditions where it was not possible or not economical to do that, should desulphurisation in the basic cupola be considered.

Foundry Properties of "Basic" Cast Iron

MR. H. MORROGH (British Cast Iron Research Association) said the founding properties of irons were affected appreciably and usually detrimentally by high phosphorus content. He understood that experiments had been made on a small scale in the course of the work described in the Reports to study grey iron castings made from metal melted in the basic cupola, and the iron founding industry would like to hear the views of the Committee members on the qualities of that grey iron, whether melting in a basic lined cupola affected founding properties, such as shrinkage, whether it affected the graphite structure of the irons, particularly in view of the fact that certain German investigators had, from time to time, pointed to the pronounced effect of slag condition on that problem.

The dephosphorisation experiments, discussed in the report, dealt with relatively low phosphorus contents, from the point of view of the iron founder. It would represent a considerable step forward if dephosphorisation could be effected from, say, 1.5 down to 0.8 per cent. It seemed that the limiting factor was the silicon, and that a low silicon content might have to be tolerated. He asked whether it would be an economical proposition to melt low-silicon material with high phosphorus content and, after melting, to restore the silicon content by a late addition.

Suggesting that, in future work on the basic cupola, attention would have to be devoted to discovering where in the furnace the dephosphorisation or the desulphurisation occurred predominantly, he said it was of outstanding importance that apparently dephosphorisation occurred most successfully, in the presence of silicon, when the silicon was added as ferro-silicon in the charge and not included in the metal that was melted. That seemed to suggest that an appreciable degree of dephosphorisation occurred in the cupola shaft and not in the well, because, by the time the metal had reached the well, whether the silicon was charged separately or was originally in the metal, it should be in the same form.

A very important desulphurisation action in cupola melting which had been omitted in the discussion, he suggested, was the straightforward reaction between iron sulphide, or sulphur in the coke, and manganese. That reaction was less efficacious at higher temperatures.

He urged that, at the earliest opportunity, a repetition should be made, using the basic cupola, of an experiment which was reported at an I.B.F. conference some two years ago, when the whole of the cupola charge was quenched. That might indicate where the carbon pick-up was occurring, and whether dephosphorisation occurred predominantly in the shaft or the well of the cupola.

MR. BOLTON said that a few experimental melts had been made with an ordinary grey iron in a basic lined cupola and, so far as could be seen, the metal had characteristics no different from that melted in the ordinary conventional acid lined cupola; the silicon loss was a little higher, of the order of 20 per cent., but the physical properties, as shown by the standard tensile test, were unchanged, as were also the founding properties of the metal.

Cost of Basic Linings

MR. J. L. HARRISON (Messrs. Catton & Company, Limited), speaking from the point of view of the side-blown converter user, said they had tried a lining of basic material—stabilised dolomite in the form of bricks—and the results were most interesting, but not very promising, from their point of view. They had tried to produce metal in the cupola which would be suitable for ultimate conversion in the converter, and they had achieved quite a large degree of desulphurisation and dephosphorisation. The phosphorus was reduced to the region of 0.01 to 0.02 per cent. with a low silicon content; the temperatures were 1,285 to 1,380 deg. (immersion readings). The carbon content

was increased by 0.3 to 0.5 per cent., and he agreed with the view that it was due to carbon pick-up in the cupola well. In normal acid practice among converter users, a number of foundries had increased the depth of the cupola well to achieve carbon pick-up. One firm, which had been operating with a receiver and had had carbon contents of 2.8 per cent., had dispensed with the receiver in order to get higher carbon contents, up to 3.2 and 3.4 per cent.

One problem he had not been able to solve was the extremely low melting rate in the basic cupola, round about half, and in one case less than half, that of the normal melting rate in the acid-lined cupola. Emphasising the importance of the cost of basic linings, he said that, for the experiment, the cost of material and labour to line the cupola was about £220, and they had got something like 10 tons of metal out of it, with very great difficulty. That might be an extreme case; but basic refractories were very much more expensive than acid refractories.

If converter users were to desulphurise, or dephosphorise, or both, in the cupola, they must consider an intermediate stage between cupola and converter for preheating the metal and re-siliconising it. To achieve successful dephosphorising, they must think in terms of silicon contents of about 0.1 per cent. He agreed with Dr. Colclough that probably they would have to separate the two processes, dephosphorising in the cupola and desulphurising in the ladle; sulphur reduction could be achieved quite successfully in normal times in the ladle. He believed the basic cupola would have to be considered as the dephosphorising medium, for steelmakers generally were faced with the prospect of specifications calling for lower phosphorus content.

Rate of Melting

MR. BOLTON said the temperatures quoted by Mr. Harrison were rather lower than those given by the Committee; and the Committee had not obtained such extremely low phosphorus figures. He felt that the problem of temperature must be investigated if progress were to be made. His own experience when he had first tried to use a basic-lined cupola, like that of Mr. Harrison, was that the melting rate, in the early stages of the blow, was only half that obtained when the furnace was ganister-lined, and it was found to be due to the inability to produce a fluid slag. As soon as the flux charge was modified, so that a fluid slag was obtained, the melting rate returned to normal.

The cost of the basic lining material was undoubtedly higher than that of acid material. The basic process could only be economic if they could derive benefits from the treatment which could not be derived in any other way; and he felt there was still a very good possibility that improvements in basic refractories would result in much more economic operation.

As to the view that it would be necessary to reheat or superheat the very low silicon metal before it could be blown to steel, he thought it should be possible to produce low-silicon metal from the basic cupola at sufficient temperature to take the cold or preheated addition of ferro-silicon and still blow it successfully to steel.

Mr. J. L. Francis (Foundry Services, Limited), commenting on an attempt, mentioned in the Second Report, to increase the oxidising conditions during melting by increasing the volume of blast to the cupola, said that even with the blast volume raised as shown they were still underblowing. The coke to metal ratio was high (1 to 6.3), and even allowing for the carbon absorbed into the 100 per cent. steel scrap charge, there was still more coke than could be completely burned by the volume of air used. The high coke to metal ratio might have some bearing on the high carbon pick up.

When adding iron oxide to obtain oxidising conditions of the slag, did it matter whether it was in the form of F_2O_3 or Fe_3O_4?

Higher Carbon Pick-up

MR. BOLTON said they had reached the point that, when using 100 per cent. steel charge in a basic cupola, the carbon contents were nearly 1 per cent. higher than were obtained under exactly similar conditions in an acid cupola. The point was that only when using the basic lining was the carbon pick-up abnormally high.

In the automobile industry it was necessary to control carbon content within very narrow limits for cylinder block and other castings; the range of carbon content available to the founder was possibly not more than 0.2 per cent. They were also forced to use very high temperature, in order to run thin sections with low-phosphorus metal. There was a certain amount of pig-iron in the charge, and the charge was of comparatively high carbon content as compared with that at Stanton Gate. They tapped intermittently, and stored metal in the well, but the carbon content of the melted metal was not nearly so high as when a basic cupola was used.

He agreed that, when an attempt was made to obtain oxidising conditions by increasing the blast, the cupolas were by theoretical considerations still under-blown. Nevertheless, they were dealing with a charge which was highly susceptible to oxidation; if a high percentage of carbon dioxide or free oxygen were present in the gases when they reached the steel immediately before it melted, rapid oxidation could occur.

Daily Patching

MR. H. PARNHAM (General Refactories, Limited) suggested that, due to the high cost of basic refractory materials and the high cost of labour, there was need to get away from the age-old custom of patching; the idea of patching daily was rather nauseating, especially when materials were expensive. Stabilised dolomite was probably not the best for that particular job, and there was need to try to cover the field of magnesite and other types of refractories.

Patching was necessary both in rammed stabilised dolomite and with firebricks; even with hard fired vitrified bricks there was a certain amount of erosion which needed to be made good every day. The flaking of rammed linings was most important, and he believed most of the wear was due to mechanical rather than chemical action. The purpose of using chemical

Basic Cupola Practice

bonds was to increase strength and in such cases there was the greater depth of vitrification, and probably greater depth of flaking, which would increase rather than reduce costs. In general, there was a need for a very abrasion-resistant non-spalling brick, preferably of the magnesite type, which was volume-stable; he suggested that the hot zone should be made so that the 4½-in. brick could be used, and that it should be run to finality without patching. As soon as it had worn back, it should be taken out and replaced by new bricks, because, in view of the cost of labour and raw materials, it was almost as costly to patch as to put in a new one.

Water-cooled Cupolas

MR. BOLTON said that one foundry had overcome the difficulty by using water cooling in the melting and superheating zones of the cupola. It was then possible to use a refractory wash over the steel plates, and patching became a thing of the past. The difficulty with the system was that 100 per cent. steel charges could not be melted, because the steel did not pick up carbon until it was fairly low in the cupola, and molten metal was deposited on the plates, which would build up gradually and would eventually stop the cupola. That did not happen to the same extent when pig iron was melted, and the system was operated successfully with pig/scrap-iron mixtures.

The system of using bricks and replacing them when worn, he had seen operated in a foundry situated 500 or 600 miles from the source of refractories supply, and they had maintained that it was the most economical method of operating a cupola. They had actually used, in an acid cupola, silica bricks 4½-in. thick, which had lasted for a complete day's melt under extremely severe conditions, melting metal for white-heart malleable castings at very high temperatures. It was their considered opinion that the most economical method was to replace the lining after each melt in the hot zone of the cupola.

The last portion of a thin lining would last for a considerable time; the lining was cooled to some extent by radiation, and the last inch lasted considerably longer than the first inch, due to the greater heat losses.

MR. W. W. HARRISON (Bagshawe & Company, Limited), as an encouragement to further work on desulphurisation in the cupola rather than outside it, said he was making very small castings in white heart malleable with a large amount of returned scrap. Consequently, he had to put a large burden of scrap on the cupola, and the resulting sulphur figure was very high. Unfortunately he could not desulphurise outside the furnace, because he must have very hot metal to pour into the moulds immediately. So that, if the basic lining were a really economical proposition, it would be of great benefit to producers of white-heart malleable iron with very high sulphur contents.

Institute Elects New Members

Additional to the two lists published last week, the Council also elected the following:—

Members

E. A. J. Autere, chemist and engineer, Högfors Bruk, Finland; T. N. Hosgood, chief chemist, Lloyd's (Burton), Limited; K. Saarikoski, chemist and engineer, Högfors Bruk, Finland; A. C. Thomas, technical representative, Foundry Services, Limited; *J. S. Bettinson, director, the Hill Top Foundry Company, Limited.

Associate Members

P. C. Davies, moulder, S. Russell & Sons, Limited, Leicester; A. G. Gardner, metallurgist, British Cast Iron Research Association; D. E. Hancox, metallurgist, Sterling Metals, Limited, Coventry; W. Picken, assistant works manager, Sinclair Iron Company, Limited, Wellington; W. E. Sarson, assistant foreman, S. Russell & Sons, Limited, Leicester; A. J. Stanyard, assistant foundry metallurgist, Phosphor Bronze Company, Birmingham; F. G. Timmins, B.Sc., foundry manager and metallurgist, G. Clancey, Limited, Birmingham; A. R. Tozer, senior pattern inspector, G. Perry & Sons, Leicester.

Associates (over 21 years)

R. A. Jones, laboratory assistant, Department of Industrial Metallurgy, Birmingham University; A. W. Matthews, metallurgist, Geo. Horgan, Limited, Birmingham.

The Boy's Own Foundry

Of some importance in the attraction of juveniles to the foundry industry is a toy casting set sold under the trade name of "Trevorcast." Unlike earlier toys, which were usually a die-casting set, this one provides sand, moulding boxes, tools, patterns and Wood's metal. Every encouragement should be given to popularise this toy as an interesting means of directing the minds of boys into a channel which establishes foundry practice as a basic process in the engineering industries. The makers, Welsh Industries Company, Bridgend, South Wales, are obviously enterprising, as they have started a "Trevor Club," a pattern for the membership badge being included, of course, amongst the components supplied.

National Brassfoundry Association

The National Brassfoundry Association has published in brochure form the report of their Golden Jubilee meeting, presided over by Mr. Albert Ellis. Membership of the Association has reached the record total of 247. A banquet is to be held on September 27 to celebrate the jubilee. At the meeting held at the Queen's Hotel, Birmingham, on April 15, Mr. R. D. Best was elected president.

Imports and Exports of Iron and Steel

BOARD OF TRADE RETURNS FOR MARCH

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in March and in the first quarter of 1947. Figures for one-quarter of 1938 are given for purposes of comparison.

Total Exports of Iron and Steel

Destination.	March, 1947.	Quarter ended March.	One-quarter of 1938.
	Tons.	Tons.	Tons.
Eire	5,011	16,561	13,930
Channel Islands	560	1,241	1,854
Malta and Gozo	520	1,115	576
Cyprus	322	665	414
Palestine	1,701	12,908	2,018
British West Africa	3,249	11,621	12,436
Union of South Africa	11,938	39,731	57,772
Northern Rhodesia	658	1,240	5,144
Southern Rhodesia	740	5,041	9,053
British East Africa	961	4,840	6,483
British India	11,601	25,538	39,670
Burma	1,627	9,984	4,628
British Malaya	3,241	12,484	16,646
Ceylon	1,076	2,877	6,508
Hong Kong	1,153	4,354	5,899
Australia	4,167	11,676	42,726
New Zealand	4,959	13,171	32,971
Canada	1,109	1,900	21,352
British West India Islands	2,393	8,758	11,063
Anglo-Egyptian Sudan	1,336	2,167	2,073
Other British Countries	3,692	10,794	4,495
Soviet Union	175	562	1,087
Finland	486	7,666	4,402
Sweden	4,970	19,874	2,994
Norway	3,360	11,359	5,068
Iceland	619	1,809	165
Denmark	5,361	20,084	21,814
Poland	29	100	622
Netherlands	7,081	23,495	12,890
Belgium	1,940	7,374	5,081
Luxemburg	30	432	26
France	3,927	7,542	3,347
Switzerland	1,397	3,496	695
Portugal	729	4,160	1,928
Spain	324	1,581	1,941
Italy	1,167	1,193	1,285
Greece	779	5,186	438
Turkey	1,940	4,230	3,439
Dutch East Indies	1,604	3,934	6,827
Dutch West India Islands	532	2,806	616
Belgian Congo	260	681	76
Portuguese East Africa	158	1,033	3,555
Syria	156	1,034	651
Egypt	3,805	12,142	8,602
Iraq	4,563	16,540	6,435
Iran	4,752	16,101	27,595
China	1,949	8,758	5,628
U.S.A.	356	4,528	547
Colombia	108	2,027	956
Venezuela	2,939	8,094	1,169
Ecuador	804	1,202	398
Peru	420	1,158	758
Chile	650	1,865	1,573
Brazil	3,008	10,384	4,248
Uruguay	1,310	2,221	1,897
Argentine	6,573	16,630	19,839
Other Foreign Countries	3,502	15,497	22,678
Total	133,777	445,444	478,969

AS SEVERAL of our readers have asked for information as to "Metalock," we are now in a position to state that it is classified as a steel primer and steel finishing industrial paint. It is made by the Hock Paint & Chemical Works, Inc., of Phœnixville, Pa., U.S.A.

Total Imports of Iron and Steel

From	March, 1947.	Quarter ended March.	One-quarter of 1938.
	Tons.	Tons.	Tons.
British India	—	505	38,908
Australia	10,633	16,607	9
Canada	20,365	44,163	29,344
Other British Countries	51	711	1,400
Sweden	628	2,158	22,449
Norway	1,915	6,747	8,444
Belgium	2,414	5,415	68,420
Luxemburg	422	1,187	14,650
France	634	754	64,337
U.S.A.	23,683	51,276	50,173
Other Foreign Countries	1,951	5,865	37,940
Total	62,696	135,388	336,068
Iron ore and concentrates—			
Manganiferous	—	18,070	15,571
Other sorts	463,610	1,420,403	1,275,468
Iron and steel, scrap and waste, fit only for the recovery of metal	8,558	39,992	158,051

Exports of Iron and Steel By Products

Product.	March, 1947.	Quarter ended March.	One-quarter of 1938.
	Tons.	Tons.	Tons.
Pig-iron	3,078	14,784	23,485
Ferro-alloys, etc.—			
Ferro-tungsten	44	110	129
Spiegeleisen and ferro-manganese	781	6,976	1,299
All other descriptions*	75	179	262
Ingots, blooms, billets and slabs	652	859	2,436
Iron bars and rods	317	1,103	799
Sheet and tinplate bars	—	—	3,095
Wire rods	234	842	795
Bright-steel bars	2,094	6,823	1,647
Other steel bars and rods	10,126	37,716	25,503
Special steel	1,317	4,045	1,233
Angles, shapes and sections	5,490	23,702	16,718
Castings and forgings	289	952	405
Girders, beams, joists and pillars	1,062	7,383	8,368
Hoop and strip	2,705	9,230	9,344
Plates, ¼ in. thick and over	9,460	33,646	32,742
Black plates	2,394	6,874	3,635
Black sheets	3,811	9,664	15,878
Galvanised sheets	3,127	10,354	36,734
Tinplates	13,736	34,985	79,830
Tinned sheets	430	794	353
Terneplates	37	191	1,081
Decorated tinplates	2	744	1,092
Cast-iron pipes, up to 6-in. dia.	3,346	11,808	12,232
Do., over 6-in. dia.	2,584	8,502	10,741
Wrought-iron tubes	17,178	60,447	54,993
Radiators and central-heating boilers	183	827	1,007
Steel rails	6,143	20,093	26,500
Sleepers and fishplates	3,368	11,896	6,346
Spikes	661	1,361	702
Signalling equipment	323	1,535	314
Other railway material	1,364	3,767	5,677
Wire	4,644	15,473	13,796
Cable and rope	2,310	6,302	4,100
Netting, fencing and mesh	1,181	3,319	2,354
Other wire manufactures	586	2,106	918
Nails, tacks, etc.	744	2,058	952
Rivets and washers	533	1,843	2,134
Wood screws	340	1,065	628
Bolts, nuts, and metal screws	1,651	5,606	4,393
Stoves, grates, etc. (excl. gas)	455	1,392	1,752
Sanitary cisterns	61	184	703
Fencing material	603	1,507	1,283
Anchors, etc.	557	2,094	1,584
Chains	484	2,062	1,573
Springs	814	1,685	983
Hollow-ware	4,332	15,098	2,676
All other manufactures	18,071	51,458	53,777
Total	133,777	445,444	478,969

* The figures for 1938 are not completely comparable with those for subsequent years.

Gazette

THE COMPANIES REGISTRATION OFFICE give notice that the names of the undermentioned companies have been struck off the register, and are thereby dissolved:—Allied Machinery Company, Limited; Alluvials Mining Machinery Company (1934), Limited; Cogar Precision Company, Limited.

ENGINEERING SPECIALISTS, LIMITED, is being wound up voluntarily with a view to reconstruction. Mr. W. L. Rowland, Cross Keys House, 56, Moorgate, London, is the liquidator. A declaration of solvency has been filed with the Registrar of Joint Stock Companies. All creditors have been or will be paid in full.

THE PARTNERSHIP between C. Stratton, E. A. Stratton, R. D. Downs and R. S. Downs, carrying on business as engineers and electro-platers at Eastcott Road, Swindon, under the style of the Swindon Plating & Precision Engineering Company, has been dissolved so far as concerns R. D. Downs and R. S. Downs, who have retired from the firm.

THE PARTNERSHIP BETWEEN Albert William Portsmouth and Douglas Haig Hemmings, carrying on business as sheet-metal workers, welders, etc., under the style of A. W. Portsmouth & Company, has been dissolved by mutual consent. Debts will be received and paid by A. W. Portsmouth, who will carry on the business under the same style.

THE PARTNERSHIP BETWEEN Leonard Donati and Clarence Victor Pilcher, carrying on business as mechanical, experimental, model and general engineers and toolmakers, at 163, Riversdale Road, Highbury, London, under the style of the Primal Engineering Company, has been dissolved by mutual consent. Debts will be received and paid by L. Donati, who will carry on the business in the future.

Parliamentary

Cost of Producing Aluminium

MR. ERROLL asked the Minister of Supply why, pending the completion of a fair contract for the purchase of virgin-aluminium ingot, he was paying a provisional price to the British Aluminium Company which was not only well below their bare cost of production, but well below the price at which the metal could be purchased in any part of the world to-day.

MR. WILMOT: The provisional price is equivalent to the landed price of aluminium purchased under Government contract from Canada.

MR. ERROLL: But surely that is not the price prevailing in Canada even when landed? Cannot the Minister pay a fair price as soon as possible?

MR. WILMOT: A price is being negotiated, and pending negotiations being completed, a provisional price is being paid. The provisional price is the landed price from Canada.

Obituary

MR. ALEXANDER HILL, retired ironfounder, died in Glasgow on April 17.

MR. HERBERT THOMAS RICE, late director of the English Electric Company, Limited, died on April 21.

MR. EDWIN SHACKLETON, chairman of Mitchell, Shackleton & Company, Limited, forgemasters, of Patricroft, Lancs, died on April 16.

MR. JAMES CONSTABLE LESLIE, managing director of David Keay & Leslie, Limited, manufacturing engineers, of Dundee, died suddenly on April 15.

MR. LAWRENCE HERBERT KING, a director and member of the board of management of Baker Perkins, Limited, engineers and iron, steel and brass founders, Westwood Works, Peterborough, died recently at the age of 61. Mr. King joined the staff of Werner, Pfleiderer & Perkins, predecessors of Baker Perkins, Limited, in 1899, and went to Peterborough when the Westwood Works were built in 1905. He was also a director of Baker Perkins (Proprietary), Limited, of Melbourne, Australia.

MR. VERNON SMITH, managing director of John Thompson (Australia) Proprietary, Limited, and John Thompson Combustion Engineering Proprietary, Limited, of Australia, and a director of John Thompson Water Tube Boilers, Limited, of Wolverhampton, has died at the age of 61. Mr. Smith began his career with the firm 47 years ago, and having developed the firm's interests in the water-tube boiler plant, visited Australia in 1922. He remained in the country to found and develop the Australian associated companies.

Presentation to Mr. T. A. McIntyre

Mr. T. A. McIntyre, who resigned his directorship of Shanks & Company, Limited, at the beginning of the year on the conclusion of 50 years' service, was recently the guest of members of the British Bath Manufacturers' Association, Limited, at a luncheon in London, when the opportunity was taken to recognise his work for the Association. A presentation, taking the form of a fountain pen, a gold wristlet watch for his wife, and a deposit with a firm of publishers to enable him to purchase books and stamps, was made.

Mr. Shaw, chairman of Allied Ironfounders, Limited, in handing over the gifts, paid tribute to the long and valued services which Mr. McIntyre had given to the bath industry. He reminded the members that Mr. McIntyre had been actively associated with the work of the organisation since its inception and that he had played a prominent part in the negotiations which led to the setting up of the International Bath Association, Limited, and thereafter acted as a member of the international committee appointed to administer the affairs of the International Association. Mr. McIntyre, in his reply, expressed his gratitude and said he would very much miss meeting his colleagues in the Association, but that he hoped that the friendships he had formed would endure.

Personal

MR. B. E. HUMBLE, labour manager, Cargo Fleet Iron Company, Limited, has retired. Mr. Humble joined the firm 41 years ago.

MR. F. WILLIAMS has been appointed a director of Markham & Company, Limited, Chesterfield. He joined the company in 1928 and was made a local director in 1937.

SIR CLAUDE GIBB, of C. A. Parsons & Company, Limited, Heaton, Newcastle-upon-Tyne, has been re-elected president of the north-eastern section of the Institution of Production Engineers.

MISS LAURA FLATHER has been appointed a life director of W. T. Flather, Limited, alloy-steel makers, of Sheffield. Miss Flather has been secretary of the company for 42 years and a director for 27 years.

MR. V. WATLINGTON, who has retired from the directorship of the British Electrical and Allied Manufacturers' Association after having been associated with it for over 35 years, received a presentation at the annual meeting in London on April 17.

MR. C. F. HUEBNER has been appointed controller of purchases to the British Oxygen Company, Limited. Previously Mr. Huebner was purchasing manager successively to Pearson & Dorman, Long, Limited, Lancashire Dynamo & Crypto, Limited, and John Fowler & Company (Leeds), Limited.

MR. ALFRED EDWARDS, Labour M.P. for Middlesbrough East, has been appointed a director of Gjers Mills & Company, Limited, Ayresome Ironworks, Middlesbrough. Mr. Edwards has been prominently associated with the business life of the town for many years. He was proprietor of Harrisons Bros., Middlesbrough, merchants, and is now a director of Harbro Supplies, Limited, Middlesbrough, and of Barkers (Contractors), Limited, London.

MR. J. M. PRIMROSE, whose retirement was announced recently, has been succeeded in his appointments with the Grangemouth Iron Company, Limited, and its associated companies, the Burnbank Foundry Company, Limited, the Camelon Iron Company, Limited, and Watson, Gow & Company, Limited, by MR. J. J. ST. CLAIR, who, since the end of the war, has been responsible for the designing and installation of mechanised plants at the works of subsidiaries of Federated Foundries, Limited.

Will

DE HAAN, PETER, European sales manager of the English Steel Corporation, Limited £5,214

Wolfram Prices Raised

As from April 23, the price of tungsten ore of standard grade from Government stocks has been raised to 115s. per unit of WO_3, delivered consumers' works. For special high-grade scheelite to the following specification—WO_3 minimum 68 per cent., tin maximum 0.60 per cent., arsenic maximum 0.10 per cent., molybdenum maximum 0.10 per cent.—the price is 120s. per unit of WO_3, delivered consumers' works.

Welsh Tinplate Plan to Go Forward

Mr. Wilmot, Minister of Supply, announced recently that decisions had been taken on the £50 million modernisation and development plan for the Welsh tinplate and steel-sheet industry. He had considered the recommendations of the Iron and Steel Board on this important scheme, he said. The Government accepted the Board's recommendations for the construction by the companies concerned of a new continuous hot-strip mill with coke ovens, blast furnaces, steel-melting shops and ancillary plant at Margam, near Port Talbot. Further, the Government agreed with the Board as to the need for new cold-reduction and finishing plants for tinplate and steel sheet. The precise location of these was under consideration by the Government in the light of the Board's recommendations and the sociological factors involved, and he hoped to make a further statement about them shortly.

Mr. Wilmot said the seheme would not be in full operation for some three years. He thought the thanks of the Government and of the House were due to the Iron and Steel Board for the expeditious way in which they had handled this matter.

Coke-oven Plant for South Africa

The Woodall-Duckham Company has received an order to the value of £1,400,000 from the South African Iron & Steel Industrial Corporation, Limited, for a complete coke-oven plant, by-products recovery plant and benzole plant. The new plant, which is to be built at Vanderbijl Park, will comprise 54 W-D Becker ovens with two complete sets of oven machines, coal-receiving bunkers with coal-blending, crushing and handling plant, coke-handling and screening plant, indirect by-products recovery plant, benzole-recovery and complete rectification plant, tar-distillation plant, and water-cooling plant, etc.

This order follows upon the two orders recently placed with the Woodall-Duckham Company for extension batteries of 45 and 19 W-D Becker ovens at the Pretoria Works of the South African Iron & Steel Industrial Corporation, Limited.

Engineering Bodies Amalgamate

The Privy Council has approved the amalgamation of the Institution of Mechanical Engineers and the Institution of Automobile Engineers. The former was founded in 1847 and is celebrating its centenary in June, and the latter was founded in 1906. Both bodies enjoy Royal Charters. The Institution of Mechanical Engineers has created an automobile division.

SCOTT ENGINEERING, LIMITED, 71, Temple Row, Birmingham, 2, entertained a distinguished company at luncheon on Tuesday at the Great Eastern Hotel, London, to inaugurate the launching of the company.

Company News

(Figures for previous year in brackets.)

Crittall Manufacturing—Interim dividend of 10% (same).

Halesowen Steel—Final dividend of 15%, making 20% (same).

British Oxygen Company—Final dividend of 12%, making 20% (same).

Craven Bros. (Manchester)—Final dividend of 15%, making 20% (same).

Quirk, Barton—Final dividend of 6% (same) and a bonus of 4% (nil), making 12½% (8½%).

George Wostenholm & Son—Net profit for 1946, £3,102 (£2,266); dividend of 10% (7½%); forward, £7,990 (£7,737).

Mellor Bromley—Net profit, £65,739 (£31,259); dividend of 10% (same); to reserve, £5,000 (£2,500); forward, £61,627 (£46,102).

Ewart & Son—Net profit for 1946, after crediting £2,972 (nil) from sale of investments, £3,113 (loss of £38,672); no ordinary dividend.

Enfield Cables—Net profit for 1946, £54,354 (£60,034); to reserve, £25,000 (nil); dividend of 7½% (12½%); forward, £4,408 (£16,304).

Hammond Lane Foundry—Profit for 1946, after depreciation and taxation, £16,352; dividend of 10% and a bonus of 2½%; forward, £6,323.

North Lonsdale Iron & Steel Company—Trading profit for 1946, £15,078; reserve for taxation, £4,000; dividend of 5%; forward, £13,361 (£9,070).

William Gray & Company—Net profit for 1946, £32,696 (£29,525); to reserve, £10,000 (same); dividend of 2½% (same); forward, £11,109 (£9,038).

James H. Lamont—Net profit for 1946, before taxation, £35,889 (£35,838); taxation, £16,858 (£17,456); dividend of 25% (same); forward, £2,356 (£2,122).

Glover & Main—Net profit for 1946, £78,971 (£61,132); dividend of 10% (11%) and a bonus of 15% (7½%), making 30% (22½%); forward, £48,367 (£45,434).

E.N.V. Engineering—Net profit for 1946, £84,003 (£82,945); to reserve, £15,000 (same); dividend of 17½% (same), plus a bonus of 8½% (same), £65,625; forward, £35,711 (£34,833).

Breedon & Cloud Hill Lime Works—Net profit for the year ended January 31, £29,911 (£19,576); final dividend of 27½%, making 35% (30%); to general reserve, £5,000 (nil); forward, £10,484 (£8,432).

Vulcan Foundry—Net profit for 1946, after providing £227,439 (£163,737) for taxation, £89,000 (£26,196); to general reserve, £50,000 (nil); dividend of 5% (same) and a bonus of 1½% (nil); forward, £51,820 (£45,782).

Fescol—Profit for 1946, after taxation, £11,971 (£6,519); dividend of 50% and a bonus of 25% (50%, no bonus); to general reserve, £3,086 (£2,500); to reserve against losses due to fuel crisis, £3,000 (nil); forward, £14,147 (£12,440).

Heenan, Beddow & Sturmey—Trading profit for the year ended November 30, after estimated provision for taxation, £21,788 (£16,868); depreciation, £3,472; provision for deferred repairs, £10,000; dividend of 15%; forward, £23,459 (£21,011).

Thorn & Hoddle—Net profit for the year ended September 30, 1946, after providing for depreciation, £3,468 (£4,462); provision for taxation and deferred repairs, £1,674 (£3,077); ordinary dividend of 10% (same); forward, £5,702 (£5,103).

British Lead Mills—Trading profit for the year ended October 31 last, after depreciation, etc., £44,332 (£32,200); taxation, £20,993 (£14,386); general reserve, £2,500 (same); contingencies, £5,000 (same); deferred repairs, £1,000 (same); dividend of 30% (same); forward, £10,444 (£7,980).

Vickers—Net profit for 1946, after providing for taxation, etc., £1,076.224 (£971,509); to contingencies, £250,000 (same); to sinking fund for redemption of 4% first mortgage debenture stock, £20,620 (£19,827); final dividend of 8½% (6%), making 12½% (10%); forward, £1,123,001 (£1,073,704).

A. Reyrolle—Trading profit for 1946, £322,054 (£295,110); other income, £17,962 (£16,787); depreciation, £68,092 (£65,743); renewals provision, £10,000 (same); staff superannuation, £26,668 (£22,278); interest, £12,250 (£5,575); taxation, £100,000 (£110,000); general reserve, £25,000 (nil); development expenditure, £20,000 (£21,509); preference dividend, £3,946 (£3,767); ordinary dividend of 12½% (same); forward, £121,914 (£120,917).

Guest Keen Baldwins Iron & Steel—Trading profit for 1946, £1.577,824 (£1,308,208); dividend from subsidiary, £24,314 (£16,476); other income, £7,960 (£11,840); depreciation, £375,000 (same); additional depreciation, £90,000 (nil); deferred repairs, nil (£50,000); debenture interest, £81,612 (£82,800); debenture redemption, £30,888 (£29,700); E.P.T., £423,000 (£186,000); tax, £277,000 (£351,000); net profit, £326,431 (£255,524); note interest, £24,289 (£24,864); note redemption, £12,071 (£11,497); preference dividend, £42,958 (£39,052); ordinary dividend of 10% (7½%). £202,125 (£137,813); forward, £199,927 (£154,939).

Associated Electrical Industries—Trading profit for 1946, including price adjustments, £1,062,915 (£1,572,573); dividends, etc., from subsidiaries, £1,137,634 (£452,590); dividends and interest, £52,037 (£58,873); profit on sale of assets, £29,068 (nil); to depreciation, £226,861 (£221,430); reserves, £29,068 (£143,159); provisions, £94,463 (£197,950); income tax, £827,166 (£970,822); net profit, £1,096,046 (£542,817); to fuel-crisis reserve, £275,000 (nil); general reserve, £200,000 (special reserve, £150,000); preference dividends, £117,446 (£106,770); ordinary dividend of 12½% (10%) and a bonus of 2½% (nil); forward, £344,400 (£335,800).

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New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Anglo Foundry Company, Middlegate Entrance, Tyne Dock, South Shields—£7,500. J. & C. R. McConway.

Lathom Engineering Company, 138-40, Bolton Road, Pendleton, Salford, 6—£10,000. E. A., J., F., and W. Taylor.

John D. Francis—Light engineers, etc. £129,000. J. K. Dick, Cheyne House, 62-63, Cheapside, London, E.C.2, subscriber.

F. Davis (Manchester), East Stanley Street, Salford, 3—Brass finishers. £8,000. E. G. Westmore, J. Stansfield, and J. Todd.

Dorset Products—Manufacturers of die-casting articles. £10,000. F. G. Clarke, Dorset House, Derby Street, Huyton, subscriber.

Express Electro-Plating Company, 285, Seven Sisters Road, Manor House, London, N.4—£1,000. P. and D. Lawson, and S. L. Gayer.

Edward Roper, off Marley Street, Atherton, near Manchester—Engineers, etc. £3,000. E. Roper, J. Seddon, and J. S. Brownlow.

Brockway Engineering Company, Green Street, Stourbridge—£2,000. R. G. Brock, G. H. Wilkinson, W. L. Hill, and C. G. Horton.

Everson Mouldings, 442, West Green Road, Tottenham, London, N.15—£1,000. A. Gibson, A. Bacon, A. Hoster, and A. G. Smart.

Polygram Casting Company, 28, Mackenzie Street, Slough—Engineers, etc. £1,000. L. R. Briggs, W. G. Stewart, A. Leigh, and T. H. Griffith.

Quality Manufacturing Company, 9a, Alfred Street, Blackpool—Ironmasters, founders, etc. £1,000. A. B. Bithell, E. J. B. Worrall, and A. Harris.

Whyte & Collins, Kelvin Works, Carters Crossing, Fenton, Stoke-on-Trent—Iron and brass founders, etc. £30,000. P. W. Collins and M. P. Whyte.

A.O. Metal Exporters, Liverpool House, 15-17, Eldon Street, London, E.C.2—£20,000. L. Phillips, W. E. Ridsdale, H. Klein and H. Roseman.

O. C. Boyce & Company, 5, Ilton Road, Penylan, Cardiff—Electrical and general engineers, etc. £3,000. O. C. Boyce, F. L. Keen, and E. Bowden.

Premier Pattern Making Company, 65, London Road, Leicester—Engineers, patternmakers, etc. £5,000. A. V. Parkin, I. Roe, and A. W. J. Merrill.

Francis Caird (Overseas)—Manufacturers of plant, machinery, tools, etc. £1,000. F. H. Caird, Africa House, Kingsway, London, W.C.2, subscriber.

R. Barsby & Company (Nottingham), 16-18, Hollow Stone, Nottingham—Mechanical and general engineers, etc. £1,000. N. Watson, G. and F. H. Joynes.

Light Fabrication, Light Fabrication Works, Victoria Street, Consett—General and mechanical engineers, etc. £1,000. H. A. Bolton and B. T. Briggs.

Roderick Products (Sales), 1, Park Road, Hampton Hill, Middx—Agents for the sale of tools, patterns, etc. £1,000. F. A. Dunn and E. W. Tempest.

Plato Manufacturing Company, 266a, High Street, Uxbridge—Engineers, welders, etc. £1,500. J. J. Plato, H. Howard, F. F. Smith and R. J. Pettitt.

D. W. Birmingham, 738, Kenton Lane, Harrow Weald, Middx.—Ironmasters, founders, etc. £1,000. D. W. and R. Birmingham, and R. B. Carpenter.

W.M.G. (Guildford), Peasmarsh Garage, Guildford, Surrey—Manufacturers of machine tools, etc. £1,000. T. N. Willis, E. J. McDermott, and W. F. Guy.

Grayston Plant & Engineering Company, 105, Tynedale Road, Strood Green, Betchworth, Surrey—£2,000. G. F. Gray, S. S. Henderson and R. E. Muckleston.

Mead & Tomkinson, 22, Barton Street, Tewkesbury, Glos.—Agricultural and general engineers. £2,000. C. H. and J. O. Mead, M. C. and E. M. Tomkinson.

Phillips Products (Dudley), 133-4, Wolverhampton Street, Dudley—Sheet-iron and other metal workers, etc. £5,000. A. and W. O. Phillips, and J. Marsh.

C. I. Jenkinson & Son, Niloc Works, Penistone Road, Sheffield—Manufacturers of machine, edge and other tools, etc. £20,000. C. I., M. E. and C. C. Jenkinson.

Teleguard, 243, Imperial Drive, Harrow, Middx—Electrical and general engineers, etc. £3,500. W. F. Tompkins, M. Slaffer, J. Goldsmid, and B. A. Meyer.

Walford Manufacturing Company, 79, Dartmouth Street, Birmingham, 7—Bolt and nut manufacturers and engineers. £30,000. F. G. Thompson and W. N. Mitchell.

Fenton, Byrn & Company, 104, Great Russell Street, London, W.C.1—Ventilating and heating engineers, etc. £5,000. H. J. Fenton, G. F. Byrn, and N. F. Parker.

Hallam & Middleton, 97-99, High Road, Streatham, London, S.W.16—Electrical contractors and engineers, etc. £2,000. I. R. Hallam, C. E. Middleton, and J. R. Cort Bathurst.

Wallis (Sloane Street), Thanet House, 231, Strand, London, W.C.2—Mechanical and general engineers, etc. £10,100. F. A. Wallis, W. Elles-Hill, D. A. Catesby and S. G. Minchin.

Test House Equipment Company, Bank Buildings, 1, High Street, Croydon—Precision, mechanical, electrical and general engineers, etc. £5,000. D. C. K. Moss and R. H. Myles.

Caufields Corporation, 150, Charing Cross Road, London, W.C.2—Manufacturers of electrical and mechanical apparatus, etc. £2,100. A. Gray, C. W. Boughton and C. Morris.

R. D. H. Thompson & Company—Electrical, mechanical and precision engineers, etc. £2,000. M. A. and J. E. Thompson, 178, Norbury Court Road, Norbury, London, S.W.16.

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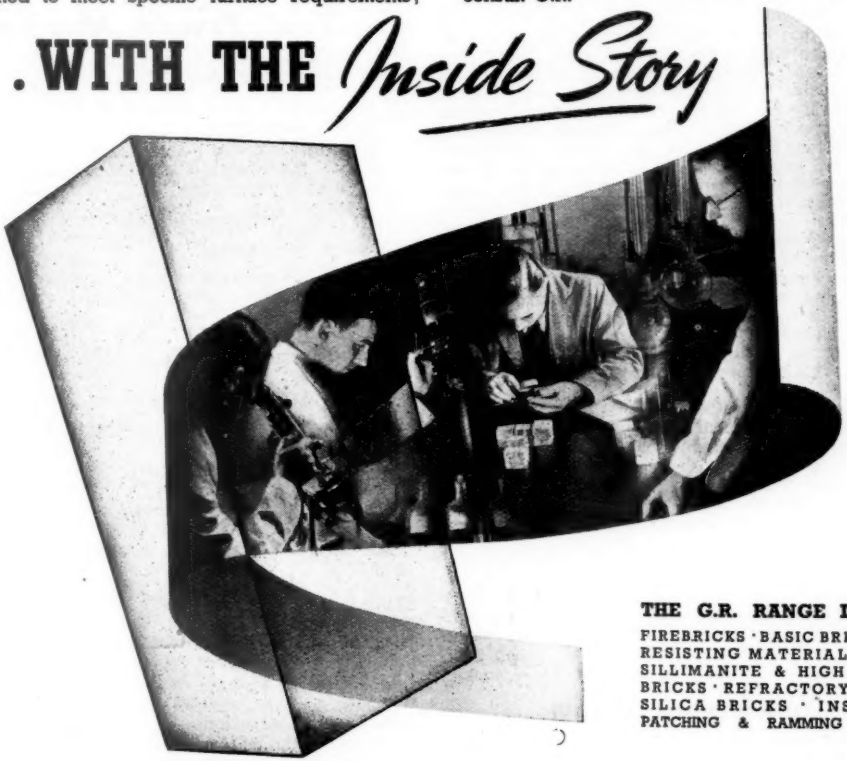

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Raw Material Markets

Iron and Steel

The pig-iron supply position remains fairly acute, particularly for high-phosphorus iron. Some foundries have had difficulty in getting furnaces to take on the quantity of iron for which they have been licensed, while, in some cases, furnaces have not been able to execute their commitments within the time limit of the licences. Foundries have sufficient work on hand to keep them at full production for a long period. The man-power position has improved, but outputs are likely to be affected through the shortage of pig-iron. It is understood that the Control authorities have been endeavouring to acquire supplies of foreign foundry pig-iron. Prices of imported iron are much above the rates ruling at home. The light foundries are heavily booked with orders for the building trade, while there are other industries pressing for supplies. The general engineering and jobbing foundries are also extremely active, and difficulty has been experienced in getting sufficient low- and medium-phosphorus iron to meet their needs. Some users have had to purchase hematite and refined pig-iron to ease the situation. There is a widespread demand for high-duty castings for the engineering trade.

The foundries are acquiring considerable quantities of scrap, larger tonnages being used because of the stringency in pig-iron, and in some areas the scrap position is not too easy. Stocks of ganister and limestone are being accumulated when possible, but foundries are unable to build up stocks of coke, as the allocated tonnages are, in most cases, only about sufficient to cover current needs.

Re-rollers of bars, strip and special sections have considerable orders on hand, but inadequate supplies of billets and blooms make it impossible for the rolling mills to achieve maximum outputs. A shortage of sheet bars has been reported of late, but the position is not so difficult as in the case of billets. Makers of semis have no difficulty in disposing of any defectives and crops which arise.

Particularly heavy pressure is being exerted by consumers of steel plates, sections and joists, and better outputs are now being achieved at the steelworks. There is still, however, a considerable tonnage of steel held up at the mills, due to lack of transport facilities and embargoes on the railways.

Non-ferrous Metals

Details of the output of fabricated copper and copper alloy products in the United Kingdom during March have been issued by the British Non-ferrous Metals Federation. The gross output of unalloyed copper is given as 24,877 tons, alloyed copper 29,992 tons, and copper sulphate 3,491 tons. The rate of copper consumption showed an improvement compared with February, when the power ban was in operation. The consumption of virgin copper during March was 28,887 tons, while the copper content of copper and alloy scrap consumed was 16,913 tons. Although these figures show an improvement on those of the previous month, there is still some leeway to be made up before the peak level of consumption—50,635 tons in January—is again achieved.

The suspension of the United States import tax on copper, other than sulphate, has now been passed and the measure awaits President Truman's signature.

There is still a serious shortage of lead. Prices are so high that producers are reluctant to see quotations move above the present level. Buyers, too, are perturbed by the current rates.

New Trade Marks

The following applications to register trade marks appear in the "Trade Marks Journal":—

"WINDOBEL"—Metal fittings. SUNRAY, LIMITED, 196, Greengate, Manchester.

"RAINAUL"—Rolled and cast metal building materials. RAINWATER CASTINGS, LIMITED, Margaret Street, Ashton-under-Lyne.

"'JEMOID' BRAND"—Non-ferrous rolled metals and alloys. JOHN E. MAPPLEBECK, LIMITED, 40-60, Frankfort Street, Birmingham, 19.

"ECONA"—Compression joints for pipes. ECONOMIC WATER SOFTENERS, LIMITED, Aqua Works, Warwick Road, Greet, Birmingham, 11.

"'FLEUR-DE-LIS'" AND DEVICE. Metal fittings, etc. THOMAS FRENCH & SONS, LIMITED, Chester Road Mills, Chester Road, Manchester, 15.

"OA" (MONOGRAM DEVICE)—Metal hollow-ware. OCTAVIUS ATKINSON & SONS, LIMITED, Tower Works, Tower Street, Harrogate, Yorks.

"COMMUTROL"—Electric generators and motors. MACFARLANE ENGINEERING COMPANY, LIMITED, Netherlee Road, Cathcart, Glasgow, S.4.

MR. JOSEPH HALL, of Penn, Wolverhampton, died recently at the age of 55. He was a partner, with his brother, in the firm of Hall Bros. (West Bromwich), Limited, iron and steel stockholders, Eagle Works, West Bromwich. Mr. Hall was a member of the executive of the Iron and Steel Stockholders' Association.

MR. CHARLES EDWARD WILLIAMS, chairman of John Williams & Sons (Cardiff), Limited, died recently. Born in 1866, he was the grandson of John Williams, who founded the business in 1844, and the son of Lewis Williams, J.P. He was a partner with his father in John Williams & Sons until 1899, and then became managing director of John Williams & Sons (Cardiff), Limited. Educated at The Leys School, Cambridge, he was the first student to be enrolled at the University College of South Wales and Monmouthshire. For many years he was president of the Cardiff and District Ironfounders' Association. He was president of the Institute of British Foundrymen in 1933.